Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

## EMBRYOLOGY.[1]

**The Sea-urchin egg.**—Hans Driesch[2] has recently made an interesting addition to his previous work upon the eggs of *Echinus mricrotuberculatus* and *Sphærechinus granularis* by the aid of an improvement in his methods.

He reaches the conclusion that by operative interference cells of the cleaving egg are made to form entodermal structures though they would normally have formed ectodermal structures.

In his larger paper[3] the author described the peculiar results obtained when eggs are subjected to pressure under a cover glass.

In such eggs the elastic membrane must be ruptured by pressure in order that it may not tend to restore the original spherical shape when the pressure is removed, but when the eggs are compressed sufficiently to break the membrane many of them are irreparably injured. Subsequently he found that if the eggs are shaken for 4 or 5 seconds in a glass the membrane may be removed from all of them without any injury to the eggs. This, however, must be done at the right time, about three minutes after the sperm has been added to the eggs and the membrane is just plainly separating itself from the egg.

These membraneless eggs are subjected to the pressure of the cover glass when they have divided into 4 cells. Under such circumstances they form a disk of 8 cells, since the cleavage spindles now lie horizontally or at right angles to their normal position.

When the pressure is removed the 8 cells divide at right angles to the plate, forming 16 cells in two layers of 8 each; however there are rarely 4 but usually only 2 micromeres formed and these 2 frequently lie out at one side of the double plate, not beneath the cells that formed them. From this double plate of 16 cells there is next formed a double plate of 32 cells. The important point here is that, as the author maintains, no rearrangement of cells takes place but merely a horizontal division of each of the 16 to increase the whole to a double plate of 32, 16 in each layer; yet the cells that gave off the peripherally placed micromeres do divide vertically and thus fill the gap in the lower plate, which would otherwise remain with only 12 cells. These 12 with, the 2 vertically formed ones and the 2 products of the 2 micromeres make up the 16 of the lower plate.

---

[1] Edited by Dr. E. A. Andrews, Baltimore, Md.

[2] Anatom. Anz., April 8th, 1893.

[3] See THE AMERICAN NATURALIST for February, 1893.

This double plate of 16 cells is the blastula stage, the author affirms, and becomes a complete larva without rearrangement of cells. It follows then that the normal animal pole of the egg is now found as a circular zone of cells about the equatorial periphery of the embryo while the vegetative pole of the normal egg is now represented by two isolated cells, one at each polar region of the entire mass; this is a disk that is becoming spheroidal by the conversion of the central parts which we have called its upper and lower surfaces into the peripheral zone or equator of the sphere.

If the eggs are kept under pressure till 16 cells are formed these are found to be in a single layer. When now this plate of 16 cells is set free and a second division in accomplished there results a double plate of 32 cells having 16 in each layer. This seems almost identical with the above described 32 cell stage and like it may form a complete normal pleuteus larva. As a matter of fact the two 32 cell embryos differ in the important item that cells having homologous positions in the two may have different relationships to the cells near them. Thus in the latter case cells at the periphery overlying one another, one in each layer, are brothers while like-placed cells in the former embryo are cousins. Another difference is that the 2 micromeres of the latter embryo do not divide into 4 equal cells but into 2 larger 2 smaller, as is the case in the normal embryo.

From the above facts, which are illustrated by camera drawings, the author concludes that so fundamental a displacement of cells has been brought about that, first, some ectoderm arises from what would have been entoderm and second, that entoderm arises from what would have been ectoderm. The first conclusion is evident from Selenka's observation that the entodermal invagination is normally opposite the animal pole, or region of micromeres. For if these experiments are credited, the vegetative part of the egg is displaced into two separate sets of cells; later but one digestive tract arises, hence some of these two sets of vegetative cells must have taken part in the formation of ectodermal structures.

If we may assume that the micromeres are a determining influence, or that the entoderm *must* arise opposite them, even in these abnormal specimens, then the entoderm will be formed from a part of the abnormal egg that is purely of the animal pole or normally to form but ectoderm.

Unfortunately the author has no observations upon these interesting stages of the abnormal larvæ and we have no real knowledge of what cells actually form the entoderm.

**A Contribution to Insect Embryology.**[4]—Under this title Mr. W. M. Wheeler presented to the Faculty of Clark University a dissertation that demonstrates the high ideals attained in Biological work at that institution.

It is sufficient indication of the character of the work to say that it is worthy of the elegant illustration it has found in the Journal of Morphology.

It is chiefly a study of gastrulation, formation of embryonic membranes, nervous system and reproductive organs in the locust, *Xiphidium ensiferum* Scud., though a much broader view is given by illustrations drawn from the author's work upon numerous other insects, notably the Orthoptera.

The eggs of this insect are laid in the willow galls produced by a Cecidomyia. They were hardened in water heated to 80° C. and afterwards kept in 70 per cent alcohol for weeks or months to allow the yolk to shrink from the chorion. Surface views and sections were then prepared by methods but little modified from those of Graber and of Patten.

The blastopore extends nearly the whole length of the germ band and is bifurcated posteriorly in a way strangely suggestive of the "sickel" of the chick embryo. It closes from each end toward the middle or future baso-abdominal region and by a process of "slurred" invagination thus gives rise to the mesentoderm.

In almost all other Orthoptera there is also, the author shows, an invaginate gastrula.

Later a most remarkable migration of the embryo takes place and complicates the difficult subject of the complex embryonic membranes.

Lying first upon the ventral surface of the egg, with its head toward the anterior and sharper end of the egg, the embryo actually sinks down into the yolk and by bending comes to lie upon the dorsal side with its ends reversed, its head toward the posterior or larger end of the egg. The appendages having meanwhile become so well developed that the leaping legs are distinguishable from the others, the embryo moves back into its original position upon the ventral side of the yolk, bending back so that it lies as at first. This second migration, however, is not through the yolk but upon its surface, over the posterior end of the egg.

These peculiar movements of the embryo, which the author would embrace under the term "blasto-kinesis," may, he thinks, be explained as of physiological use. He first shows that the primitive winged insects probably had eggs with considerable yolk and dense envelopes of chitin. The rapidly growing embryo, feeding upon the yolk must give off waste products that might accumulate in the adjacent yolk. Hence, it would be of advantage if the embryo could move away to yolk not contaminated.

---

[4] Journal of Morphology, Vol. VIII, No. 1, 1893.

From a comparative view of similar movements in Orthoptera the author infers that the more complete migration movements are primitive and that the more restricted movements have been more recently assumed; while in other groups various stages of disappearance of these blasto-kinetic phenomena have been described.

A classification of the insects based upon these movements and the character of the embryonic membranes would not, the author is convinced, conflict with that of Brauer, though the embryological evidence would tend to subdivide the Orthoptera or raise the value of the families of this group.

These embryonic membranes in Xiphidium are very numerous and complicate the above movements of the embryo, are, perhaps, the cause of the return movement. The serosa covering the entire yolk becomes cut off from the folds, amnion, covering the ventral face of the embryo so that the embryo first sinks into the yolk free from the serosa, which surrounds everything, but carrying with it the amnion. When the return trip begins, however, the amnion is again grown fast to a super-jacent membrane, the indusium, and is ruptured before the embryo can advance. This it does by becoming evaginated from the pouch of the amnion, out of which, also, an amniotic liquid escapes. The reflexed membranes do not form the dorsal surface of the future insect but are thrown off; in fact this is the case, the author thinks, in all insects: the envelopes may be variously absorbed or cast off in different cases, but in all they are to be regarded as specialized organs that have performed their part and are not used again in the formation of the body wall of the insect.

The indusium to which the amnion adheres is a most remarkable organ that first appears as a faint disk of cells anterior to the embryo when the blastopore is open.

Later this plate of cells is for awhile connected with the head lobes of the embryo, which then assumes a clover leaf outline, disappearing when the plate becomes again free.

This plate of cells is grown over by the serosa so that an amnion is formed over it just as over the embryo, the edges of the plate rising up to meet as a thin amnion beneath the serosa. This amnion is cut off from the serosa; it may be called the outer indusium to distinguish it from the thicker disk of cells, the inner or true indusium, lying upon the yolk. The indusium is then a double body lying anterior to the embryo and free. So it is not carried away when the embryo sinks into the yolk but remains and grows in all directions as a double layer between the serosa and the yolk. This double sac externally meets itself on the dorsal mid line of the egg and fuses with itself, inner indusium with inner, outer with outer. Thus the embryo becomes covered in by four cellular membranes; of these the inner indusium also secretes a granular substance and a cuticle.

As to the origin of these structures the author inclines to the mechanical conception regarding the amnion, since the insect may be regarded as sinking down from the surface in its formation much as in the case of some "invaginal disks," heads of cysticercus, the nemertean in the pilidium, etc. The indusium is, however, a structure found only in the Locustidæ, but may be homologized with a solid mass of cells, the so-called micropyle of certain Poduridæ. This micropyle in turn is comparable to the "dorsal organ" of crustaceans which possibly goes back to some sucking disk of some remote annelid-like ancestor.

The author's discoveries regarding the formation of the nervous system form one of the most interesting chapters of the present contribution and add to the evidence for the derivation of insects from annelid ancestors. The first recognized start of the nervous system is when the blastopore is still open and many large clear ectoderm cells are distinguishable in groups amongst the superficial common ectodermal cells. These large nerve-formative cells soon sink beneath the surface and are arranged in four long rows on each side of the blastopore. When that closes a median row is formed between the above four right, and four left rows. From these lateral and median rows of large cells the whole central nervous system is formed, at least all its true nervous substance. These cell rows do not, however, become directly converted into ganglion cells, but disappear, it is thought, after having budded off a mass of daughter cells. Each cell in one of the rows buds off successive cells that form vertical strings of cells; these strings form the thickness of the nerve cord and become the ganglion cells with their nerve processes. The continuous ganglionic mass so formed becomes divided into sixteen successive ganglia which are reduced by fusion to ten.

The brain is directly continuous with the ventral cord and, at least in the middle and posterior of the three regions into which it may be divided, differs from the ventral ganglia chiefly in the lack of the middle row of cells.

Contrary to what would be expected the optic nerve fibres seem to grow out from the brain toward the ommatidia of the eye.

While the author supports the view that the rows of nerve-cord forming cells in insects are homologous with the neural cell-rows of annelids (especially since they are most clearly shown in the oldest winged insects, the Orthoptera) he recognizes the possibility of this being merely a case of precocious segregation.

Another interesting part of the paper deals with the formation of the gonads and the sexual ducts.

The mesoderm is early split up into eighteen pairs of blocks, which become hollow and extend from the region of the definitive mouth to that of the definitive anus, the length of the blastopore. Two pairs correspond to the second and the third division of the brain, the others are in the thorax and abdomen. The first pair send out hollow diverticula into the antennæ; those back of the head send diverticula into the limbs.

In the walls of these hollow mesodermal sacs on the side next the median plane and the yolk, certain large cells become recognizable as the germ cells. These cells are formed, however, in the abdomen in the first to the sixth segments. They are of mesodermal origin, apparently, and first recognized when thus distributed in segmentally arranged clusters in the walls of the mesodermal sacs. In one abnormal case such germ cells occurred also in the tenth abdominal segment. These germ cells fall into the cavities of the mesodermal sacs and multiply by caryokinetic division. The six successive masses of germ cells become connected into one ovary or one testis by the outgrowths of solid diverticula from each sac to the one anterior to it and subsequent fusion.

The sexual ducts arise also from these mesodermal sacs. Thus, while in the head and thorax the diverticula that go to the limbs are converted into their muscles, the diverticula in the abdomen either disappear along with the transitory appendages or else remain as parts of the sexual ducts. In the male the mesodermal diverticula of the tenth abdominal segment remains as the terminal part of the sperm duct. The rest of the duct is formed from a solid ridge on the inner wall of the mesodermal sacs between the tenth segment and the anterior six forming the testis. The ducts then may be regarded as hollow outgrowths of the cœlomic sacs. In the female these diverticula are in the seventh segment, but at the same time there is a pair in the tenth. While the former become the oviducts, the latter, representing the terminal ampullæ of the sperm ducts, ultimately disappear. With the disappearance of most of the abdominal appendages there is still a retention of the posterior ones to form the ovipositor. The author makes out a clear case for the belief that this structure is formed from two or three pairs of real limbs.

The reproductive organs thus show resemblances to those of annelids, not only in the marked metameric character of the gonads, or clusters of cells on the cœlomic walls, but also in the fact that the ducts arise as cœlomic diverticula, since these diverticula may be homologized with nephridia by the aid of the condition of things probably existing in Peripatus.